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ABSTRACT

The effectiveness of schools and the levels of investment in schooling have been in question since the 1966 Coleman report "Equality of Educational Opportunity." Based on a theory of "knowledge-ability," this study challenges the assumption that given "inputs" will yield equivalent effects or "outputs." In this study, 120 elementary schools were randomly selected, and questionnaires were mailed to the principals eliciting background data on the school, its pupil population, resources, and faculty. Each principal was asked to identify the three "most outstanding" teachers in the third-, fourth-, and fifth-grade levels. The teachers were mailed questionnaires and inventory checklists of approved instructional practices that represent tested pedagogical techniques supported by authorities and research evidence. The extent to which approved practices were reported being utilized provided some measure of the level of knowledge-ability of the teachers. The variation in teacher knowledge-ability within schools was found to be considerably greater than the interschool differences in knowledge-ability. In conclusion, the authors suggest that the study of knowledge-ability of teacher populations rather than of schools will likely be a more productive avenue for improving the effectiveness of schooling. (Author/MLF)

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TEACHER KNOWLEDGE-ABILITY AND PUPIL ACHIEVEMENT

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The policy of educational retrenchment, stemming from the Nixon administration's Presidential Commission on School Finance during the early 1970's and extending throughout the decade, was accompanied by federally sponsored research showing that any further investment in education will have no appreciable effects on disadvantaged children and youth. The Coleman Report (Coleman, et al., Equality of Educational Opportunity, 1966) was used in the 1970's as "evidence" that the schools are virtually inconsequential or marginal institutions in changing the lives of the disadvantaged. Paradoxically, from his research, Coleman had concluded that for the disadvantaged, "It is important to replace the family environment--by starting school at an earlier age, and by having a school which begins very early in the day and ends very late" (Coleman, "Equal Schools or Equal Students?," The Public Interest, Summer 1966, p. 74).

However, Jencks and his associates used Coleman's data to "prove" an opposite conclusion, namely that schools make no difference. According to Jencks, "The character of a school's output depends largely on a single input, namely the characteristics of the entering children" and that "everything else (regarding the characteristics of the school) "is either secondary or completely irrelevant" (Jencks et al., Inequality, 1972, p. 259). Leading social scientists were quick to endorse the views of Jencks. Stinchcombe ("The Social Determinants of Success," Science, November 10, 1972) and Lipset (in Hodgson, "Do Schools Make a Difference?," Atlantic Monthly, March 1973,

p. 35) immediately treated the Jencks study as valid--with Lipset declaring, "Schools make no difference." (None of the social scientists drew the same conclusion regarding higher education, namely that "universities make no difference.")

The new era of educational retrenchment led to the establishment of a Presidential Commission on School Finance which contracted the Rand Corporation to review the research literature on the question of the effects of schooling. Although the report of the Rand Corporation acknowledged that there was a lack of research identifying the classroom variables as related to achievement, it concluded that "research has found nothing that consistently and unambiguously makes a difference in student outcomes," and it went on to offer this educational policy proposition: "There seem to be opportunities for significant redirection and in some cases reductions in educational expenditures without deterioration in educational outcomes" (The Rand Corporation, How Effective is Schooling?, 1972, p. xiii). Moynihan promptly cited the Rand report as evidence that "there is a strong possibility that we may be already spending too much" (Moynihan, "Equalizing Education: In Whose Benefit?," The Public Interest, Fall 1972, p. 73).

Not only were such negativistic reports and pronouncements given wide coverage in the popular press, but they gave rise to a number of pseudoscientific articles in the popular press claiming that as educational expenditures go up, student achievement goes down (Armbruster, "The More We Spend, The Less We

Learn," The New York Times Magazine, August 28, 1977).

In "proving" their case, the social scientists and the journalists have conveniently ignored the fact that the research cited fails to account for almost two-thirds of the variables--the two-thirds representing the proportion of variance beyond the measurement capability of the research instruments and methodological design (Thorndike, International Study of Educational Achievement, Reading Comprehension Education in Fifteen Countries, Halsted Press, 1973). Aside from the growing evidence that macrostatistical survey research is inappropriate for identifying the qualitative variables that are related to eductional achievement, social scientists, according to Myrdal, suffer from a negativistic bias and find it much easier to build their reputation by "debunking" established institutions and by using narrow empirical data opportunistically to support their biases (Myrdal, Objectivity in Social Research, Pantheon, 1969).

Various studies, both in the United States and abroad, have begun to produce positive findings concerning the effects of education (Hyman, Wright and Reed, The Enduring Effects of Education, University of Chicago Press, 1975; Rutter et al., Fifteen Thousand Hours, Harvard University Press, 1979; Rehberg and Rosenthal, Class and Merit in the American High School, 1978). However, such studies have been directed either at a secondary analysis of existing sample surveys (Hyman et al.), or have been focused on limited administrative

variables or characteristics affecting overall school climate (Rutter et al.), or have been limited mainly to questionnaire data (Rehberg and Rosenthal). Specific and comprehensive qualitative variables relating to the ecology of the classroom have not been assayed systematically in connection with achievement. When research is directed at such variables, the researchers have overlooked the strong likelihood that there is a "cancelling-out" effect in the inter-classroom, inter-school, and inter-school system analyses. As a consequence, the large-scale research continues to yield inconclusive relationships between specific educational resource variables or inputs and pupil achievement. Typifying such findings is the National Report of the United States for the International Educational Achievement Project--the largest single educational research project ever undertaken--in which the following conclusion is reached:

> The failure of most of these variables to emerge in the regression analyses in any subject or at any level suggests that, within the ranges normally found, they are simply unrelated to achievement. The lack of relationship occurred not only in the United States but in virtually every other country as well. This inability to detect potent instructional variables is somewhat discouraging. It may be that either the variables included in the present study were not the educationally important ones or that survey research methods are inappropriate to the task. Clearly, further study is needed (Wolf, Achievement in America: National Report of the United States for the International Educational Achievement Project, Teachers College Press, 1977, p. 190).

The research undertaken by us was designed to overcome the conceptual and methodological impasse in the studies on the

effects of schooling. It is based upon a theory of knowledge-ability (Tanner and Tanner, Curriculum Development: Theory Into Practice, 2nd ed., 1980, pp. 728-729, 741).

A fallacious assumption in educational policy, research, and practice is that given "inputs" will yield equivalent effects or "outputs" in all classrooms and schools. However, different classrooms and schools are characterized by vastly different knowledge-ability levels. Given equivalent incremental resources, some teachers will have the knowledge-ability to capitalize on the incremental resources in effecting improved learning outcomes, whereas other teachers will not. Therefore, we challenge the assumption that given inputs will necessarily yield equivalent outputs, where knowledge-ablity is not held constant.

We believe that researchers investigating the effects of schooling have failed to account for almost two-thirds of the variance, (Thorndike, 1973) precisely because this critical intervening variable (knowledge-ability) has been ignored. When a negligible relationship has been found between school spending and student outcomes, they have quickly leaped to the no-school-effects conclusion.

Our first step was to develop an inventory-scale of approved instructional practices derived from the professional literature. Approved practices represent tested pedagogical techniques having consensual support of authorities along with evidence of research support. Our assumption is that teachers

and schools of high knowledge-ability will exhibit a considerable number of approved practices in comparison to teachers and schools of low knowledge-ability.

Approved practices abound by the hundreds in the professional literature, such as publications of the National Council of Teachers of English (NCTE) and the International Reading Association. For example, one NCTE publication, Classroom Practices in Teaching English (Chapp, 1977) recommends some 34 classroom practices. A national study by the National Council of Teachers of English found that the teaching of composition is largely error-oriented, whereas it should be idea-oriented. Moreover, pupil assignments and teacher-made tests emphasize rote learning of facts and information to the neglect of comprehension, analysis, and the application of knowledge (Applebee, A Survey of Teaching Conditions in English, 1977, 1978). Similar findings have been reported in mathematics (Conference Board of the Mathematical Sciences, Overview and Analysis of School Mathematics, Grades K-12, 1975). It follows, then, that teachers of high knowledge-ability will utilize approved practices to a far greater extent than teachers of relatively low knowledge-ability.

The research on the effects of schooling not only has failed to take such factors into account, but has tended to focus on school characteristics and practices without assessing the qualitative aspects of these characteristics and practices.

In this study, 120 elementary schools were randomly selected, and questionnaires were mailed to the principals eliciting background data on the school, its pupil population, resources, and faculty. Each principal was asked to identify his three "most outstanding" teachers on the third-, fourth-, and fifth-grade level. This was done to minimize teacher variability within and among the schools in the study. Seventy-four percent of the principals responded. Questionnaires and inventory checklists of instructional practices and classroom resources were mailed to the designated teachers, providing us with completed returns for a total of 68 schools. The inventory of practices on the teacher questionnaire provided us with a measure of the extent to which approved practices were reported being utilized and this, in turn, provided us with some measure of the level of knowledge-ability of the teachers.

The study[1] employed the typical production-function rationale with respect to the statistical method of analysis, by utilizing multiple regression techniques to assess both the singular and cumulative impact of the variables upon explained inter-school variance.

The data obtained from the Principal's Questionnaire were used to characterize the school as a whole, relying on such variables as mean IQ, average weekly library circulation,

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[1]Nicholas Celso, The Knowledge-Ability Factor and School Effectiveness, unpublished doctoral dissertation (Rutgers University, 1978).

per-pupil instructional expenditure, mean reading achievement,[1] and socioeconomic status (DFG).[2]

Some twenty-eight variables were initially identified and statistically refined throughout the study, culminating finally with four major variables: IQ, per-pupil instructional expenditure, SES, and knowledge-ability. The remaining variables were sequentially examined for their incremental explanatory power, and deleted or combined.

A methodological refinement of the study was the use of intensive on-site follow-up observations of a subsample identified as high or low knowledge-ability schools. Our purpose here was to check the reliability and validity of the data reported on the questionnaires, and to develop greater insight into the nature of such schools for future studies. The high and low knowledge-ability schools were identified using the data reported by the principals. These were fed into a multiple regression equation using fourteen "independent"[3] variables to account for between-school variation in reading achievement.

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[1] As measured by the uniformly administered New Jersey Educational Achievement Tests.

[2] DFG: District Factor Group, an index of socioeconomic status comprised of parents' educational background, occupation, per capita income, poverty levels, unemployment rate, mobility, etc. See New Jersey Eductional Achievement Tests State Report, 1975-76 (Trenton, N.J.: The Department), pp. 7-9.

[3] We note in passing the problem of multicolinearity, and will return to it later.

The variables used included building-aggregated estimates of intelligence; number of disadvantaged students; building, district, and class size; library-circulation rate; per-pupil instructional expenditure; teacher salary and experience; teacher-pupil ratio; socioeconomic status; and number of minority students.

The regression accounted for just under half of the variance in inter-school reading achievement, and was significant at the .001 level. Based on these data, each school's expected reading achievement was predicted, standardized, plotted on a graph, and analyzed as a standardized residual. By comparing predicted to observed achievement, we hoped to identify "overachieving" and "underachieving" schools in terms of their standardized deviation from the mean. These schools were to be analyzed in terms of the relationship of pupil achievement to knowledge-ability level as evidenced by the utilization of approved practices. This process was predicated upon the assumption that enough of a variation among the schools would be observed for highly discrepant cases to appear. As expected, the majority of the schools tended to cluster tightly around the mean, falling within plus-or-minus one standard deviation of the mean residual. The deviations observed ranged from a high of 9.78 points to as low as -14.5 points, the standard error equaling 3.3 points.

Twelve highly deviant schools (2 or more standard deviations from the mean) were selected for on-site analysis.

We note here the relatively small between-school variance, consistent with other research findings. For example, Coleman found that only ten to twenty percent of the total variance in achievement was attributable to between-school variations (1966, p. 296). This has often led to the conclusion that significant differences among schools do not relate to achievement differentials, and that within-school variance ought to be our more focused concern. However, as the Rutter study (1979) suggests, there is reason to suspect that critical between-school variations do affect learning outcomes, and that certain qualitative aspects of the ecology of the school and classroom have been overlooked. As will be explained in more detail momentarily, our data tend to show that certain critical variables which have generally formed the foundation of most studies of school effectiveness, such as per pupil expenditure and utilization of school resources, have been inaccurately portrayed.

Having identified a subsample of deviant cases for later visitation, we next endeavored to analyze the entire data set based on both teacher and principal responses for all the schools. We began by examining the impact of SES factors upon our sample, by entering estimates of SES (DFG), intelligence, minority population, number of disadvantaged pupils, per-pupil expenditure for instructional materials, and building and district size into our regression. Our best equation, significant at the .001 level, accounted for about two-thirds of the

overall variation.

From our initial analysis, we concluded that the level of pupil expenditure on instructional materials, class. building and district size; and the proportion of disadvantaged and minority[1] students, had no appreciable impact upon the explained sample variation in achievement.

At this point in the analysis, we had retraced the steps typically taken by others seeking to ascertain the impact of SES versus school-based factors in determining achievement, and had we stopped here, we would have concluded similarly that background factors do tend to overwhelm the relatively negligible influence of school resources upon pupil achievement. Yet, we knew from our preliminary analysis of the principals' returns that certain schools' observed achievement greatly exceeded their predicted achievement.

We knew that we had to attempt to capture the theoretical effects of the knowledge-ability factor by developing a host of qualitatively-oriented variables which could be fed into the equation. In constructing this proxy, we began with a recognition that past investigations have traditionally fragmented a hypothetical array of teacher competencies and practices for statistical analysis and have usually come up empty-handed. In counter distinction, we view the classroom experience as a dynamic, organic whole not amenable to such

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[1]Probably due to the relatively small variation of this variable among the sample schools.

dissection. Fragmenting a complex behavior, such as teaching-learning, into verbal interaction, or questioning techniques, and then searching for the measure of association between the target variable and some outcome is likely to produce inconsistent results because the context within which such targeted behaviors are observed varies from one classroom to another. Thus, we sought to observe the application of integrated behavioral sets in their normal setting. Put differently, we tried to observe the application of approved instructional practices in a holistic manner, based on the contention that knowledge-ability would be manifest in the differential success of such application on a school-to-school basis.

The qualitative, holistic character of the instructional practices examined made quantification a problem. We were unable to develop an equitable weighting scheme which was wholly satisfactory, and had to settle for a simple aggregate frequency count of the practices used in each building. This resulted in a numerical index for each school which represented the mean number of designated approved instructional practices reportedly in use. More work needs to be undertaken to construct a more appropriate instrument which accounts not only for frequency of use, but also quality of use, of each approved practice.

A total of forty-seven instructional practices were included in the inventory. Unfortunately, determination of the individual relationship each bore to student achievement--holding intelligence, SES, and school resources constant--was

beyond the scope of the study. But, our data clearly suggest the need for such analysis.

The aggregated impact of the approved practices variable was assessed by entering it into the regression equation together with the SES and school resource data previously mentioned.

Taken together, our indices of school-based resources and activities accounted for an additional 10.2 percent of the variance beyond the SES-based variables. This is about the same percentage explained by school-related factors in the studies of international achievement in education. And yet, we were perplexed by the apparent inability of our hypothetical knowledge-ability proxies to significantly account for a greater proportion of the variance.

Based on the foregoing, it might seem reasonable to have concluded that there is no significant positive correlation between school spending and student achievement, and that the knowledge-ability factor hypothesized did not exert an appreciable impact upon student outcomes. However, the results of twelve intensive on-site visitations conducted by teams of trained observers revealed a number of intriguing factors which led us to reject both of the above mentioned conclusions. Two major findings center on gross discrepancies in the reported versus actual building-level expenditures, and the high degree of within-building variaton of teacher knowledge-ability.

Despite what appeared to be a reasonable level of reliability for the expenditure figures reported for each school, it became increasingly apparent that the reported spending data only accounted for a part of the actual spending. To begin, a large portion of the spending conducted in the schools visited did not emanate from allocated budgetary sources. In many instances, schools and classrooms were equipped with parent-raised monies and donated services and items--amounting to several thousands of dollars annually. Items purchased included TV receivers, tape recorders and casettes, microscopes, and so on--with additional funds provided teachers for discretionary use. Some schools enlisted parents in instructional and other supporting roles. In a school where the district refused to employ a full-time certified librarian, for example, no less than twenty-five parent volunteers manned the facility on a rotating schedule without pay.

We could go on and on, but suffice to say that involved parents comprise a heretofore unrecognized source of significant school revenue. The parents gave generously of themselves, often to compensate for apparent economic deficiencies in the schools.

Not only parents, but teachers, too, appeared to contribute personally to school expenditures. In the course of our many interviews with teachers, it became clear that they often spent personal funds to equip their classrooms. They systematically

purchased books, displays, learning-center equipment, bulletin-board supplies, dittos, magazines, newspapers, and the like. Often they furnished their classrooms with soft chairs, sofas, TVs, display tables, aquariums, terrariums, pets, plants, and carpeting.

To ascertain the impact of parent-teacher expenditures on the reported per-pupil expenditure, we carefully and conservatively documented in one of the schools only those supplementary expenditures directly related to the instructional programs. We found that the supplemental expenditures effected an increase in the reported per-pupil expenditure by almost 29 percent. The effects of this change are demonstrated in the appreciable increase in the correlation between the revised spending levels. The new correlation equaled +.65, explaining about 42 percent of the variance. This represents an increase of over 20 percent in the strength of the relationship between spending and achievement scores just by revising the expenditure estimate in one-out-of-four schools in a district. If such a small revision can effect so dramatic a change, what might the systematic application of this procedure on a large-scale basis reveal?

Even if systematic spending estimate controls were implemented, however, our findings suggest that teacher knowledge-ability would have to be simultaneously controlled. To this end, we paid particular attention to the teachers' utilization of school resources during the observations. Again, there was

extreme variation within the buildings. Time does not permit any discussion of these extremes, but the point to be made is that the contributions of teachers of high knowledge-ability were cancelled out by teachers of relatively low knowledge-ability within the same school. this mitigated against finding any significant relationship between teacher knowledge-ability and pupil achievement on a school-by-school basis.

In a further study, we plan to examine knowledge-ability as a function of the teacher in the classroom rather than as a function of the total school.

A more adequate, realistic approach to the specification of school spending estimates is clearly needed. Even the use of building-level averages in this study, instead of the usual district-wide averages, was insufficient. Although we could not determine whether the obtained data had overestimated or underestimated the actual expenditure, it is certain that the between-school variance in expenditure was underestimated.

In contrast to Coleman (1968, p. 105) who observed a remarkable similarity in school facilities, this study has shown the existence of a notable degree of inter-classroom variation in the availability of certain learning resources (e.g., classroom libraries), the appropriateness and use of instructional practices, and teachers' personal contributions to their classrooms. Often, the last of these differences (personal contributions of the teachers) was manifested in the form of donated services, finances, furnishings, and numerous

and sundry learning materials. So extreme was the difference between some of the classrooms observed that the vivacity of one was effectively negated by the drabness of another within the same school, in the statistical teacher-averaging procedure employed. There is no question that the building-level estimates of instructional expenditures failed to capture such differences and that teacher differences for knowledge-ability were cancelled out in the inter-school analysis. Moreover, our use of principals to designate "outstanding" teachers was of questionable validity.

A problem in the research on the effects of schooling is that the studies typically involve entire schools and school systems, including large-scale surveys of national systems. Whether the research is at the school-building level, district level, regional level, or national level--the impact of teachers having high knowledge-ability is cancelled out by other teachers of relatively low knowledge-ability. The consequence is that the potentially powerful effects of schooling are not in evidence. Such research must be directed intensively at the classroom level in a variety of schools and school systems, enrolling a significant proportion of disadvantaged as well as more advantaged children. We are proceeding to design a comprehensive instrument for identifying teachers of high and low knowledge-ability with knowledge-ability scales developed from the approved practices in the professional literature. Through an independent assessment of pupil achievement in self-contained

elementary classrooms, the impact of teachers and of various approved practices will be identified according to teacher knowledge-ability levels.

The potential impact of such a study for inservice and preservice teacher education, and for the improvement of learning, would be enormous. Although the professional literature contains considerable data on approved practices, such practices have never been brought together as an instrument for assaying teacher knowledge-ability and for establishing a powerful and consistent learning environment. The utilization of such an instrument for the systematic implementation of approved practices by teachers on a school-wide basis would provide for a powerful and consistent learning environment. If such implementation will result in significant increments in pupil achievement, as hypothesized, the treatment and the outcomes could be easily replicated in virtually any school. Whereas the recent research has been focused on school characteristics and, therefore, is of doubtful replicability, the proposed research is focused on the interrelationships of actual practices or functions in the learning environment--practices and functions that can be adopted on the widest scale.

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